

## ***Diceronema versterae* gen. n., sp. n. (Atractidae: Cosmocercoidea) from the Black Rhinoceros, *Diceros bicornis bicornis*, in South Africa**

L. M. GIBBONS,<sup>1</sup> S. E. KNAPP,<sup>2, 3</sup> AND R. C. KRECEK<sup>3</sup>

<sup>1</sup> International Institute of Parasitology, 395A Hatfield Road,  
St. Albans, Herts AL4 0XU, United Kingdom,\*

<sup>2</sup> Veterinary Molecular Biology Laboratory, Montana State University,  
Bozeman, Montana 59717, and

<sup>3</sup> Department of Veterinary Tropical Diseases, Faculty of Veterinary Science, University of Pretoria,  
Private Bag X04, Onderstepoort 0110, South Africa

**ABSTRACT:** *Diceronema versterae* gen. n., sp. n. (Atractidae: Cosmocercoidea) is described from the stomach of a black rhinoceros, *Diceros bicornis bicornis*, from the Umfolozi Game Reserve, KwaZulu-Natal Province, South Africa. The new genus and species differs from all other genera in the family Atractidae in the presence of a cup-shaped buccal capsule, the presence of symmetrical cervical papillae each with 4 prongs, the restriction of spines to the ventral surface of the female tail, the presence of caudal alae on the posterior end of the male, the ornamentation on the ventral surface of the male, and the structure and arrangement of the male caudal papillae.

**KEY WORDS:** *Diceronema versterae*, Atractidae, Cosmocercoidea, new genus, Nematoda, new species, taxonomy, black rhinoceros, *Diceros bicornis bicornis*, KwaZulu-Natal Province, Republic of South Africa.

Nematodes were collected from the stomach of a female black rhinoceros, *Diceros bicornis bicornis*, that died in the Umfolozi Game Reserve, Kwazulu-Natal Province, Republic of South Africa in June 1993. Approximately 2,100 specimens were present in the stomach contents. Examination of these nematodes revealed that they belonged to the family Atractidae (Railliet, 1917 subfamily) Travassos, 1919. Adamson and Baccam (1988) described the family as a morphologically diverse group whose only common characteristic is the capability for autoinfection, i.e., the viviparous females produce larvae which quickly develop into mature adults without passing out of their host into the external environment. The family has been clearly divided into 2 groups by Chabaud (1978) and Adamson and Baccam (1988) on the basis of the morphology of the esophagus and the presence of a monodelphic or didelphic female reproductive tract. The present specimens from the rhinoceros are monodelphic and have features not found in any other attractid. These nematodes are described and found to represent a new genus and species.

### **Materials and Methods**

The stomach ingesta was fixed in 10% formalin. Initially, one hundredth of the ingesta vol-

ume was examined microscopically. Subsequently, an additional nine hundredths of the ingesta volume was examined microscopically for recovery of further specimens for examination. Specimens were preserved in 70% alcohol with 2% glycerine added. They were cleared for examination in lactophenol and lactoglycerol and 1 specimen was mounted in Berlese's Fluid to examine the spicules. Some specimens were stained in Horen's trichrome. Drawings were made with the aid of an Olympus Drawing Attachment BH2-DA. Type specimens are deposited in the United States Department of Agriculture National Parasite Collection at Beltsville, Maryland, U.S.A. and the helminth collection of the International Institute of Parasitology, United Kingdom. Measurements are in millimeters unless otherwise stated.

### **Results**

#### **Family Atractidae (Railliet, 1917 subfamily) Travassos, 1919**

#### ***Diceronema* gen. n.**

**DIAGNOSIS:** Body elongate, attenuate, and transversally striated. Mouth with rudimentary dorsal and ventral lips; 2 pairs of submedian cephalic papillae lateral to mouth opening. Cup-shaped buccal capsule; anterior portion or cheilorhabdion divided dorsoventrally overlapping rim of mouth opening; posterior portion or pror-

\* An institute of CAB International.

habdion formed by dorsal and ventral curved semilunar plates. Cervical papillae present divided into 4 sharply pointed prongs articulate with plates in body wall. Esophagus divided, corpus distinct with distal bulb, posterior portion not distinguished into isthmus and bulb. The elongate nerve ring extends posteriorly from corpus of esophagus and excretory pore opens in region of nerve ring. Male tail coiled ventrally; 5 pairs of pedunculate caudal papillae asymmetrically arranged, 3 pairs of sessile papillae near the distal end with an additional pair of sensory organs, possibly the phasmids, adjacent to the median and distal pair; ventral cuticular flap with 2 small projections at distal tip of tail; spicules unequal, right spicule with a barb at distal tip; slender caudal alae present. Female vulva opens just anterior to anus; viviparous. Adults parasitic in stomach of rhinoceros.

*Diceronema versterae* sp. n.  
(Figs. 1–18)

**DESCRIPTION** (based on 15 male and 14 female specimens): Body elongate, attenuate, and transversally striated. Mouth with rudimentary dorsal and ventral lips; 2 pairs submedian cephalic papillae lateral to mouth opening. Cup-shaped buccal capsule (Figs. 3, 4, 9, 13), anterior portion or cheilorhabdion divided dorsoventrally overlapping rim of mouth opening; posterior portion or prorhabdion formed by dorsal and ventral curved semilunar plates. Cervical papillae symmetrical, projecting from body surface (Figs. 1, 2, 13), each with 4 sharply pointed prongs, joined at the base, which articulates with plates in body wall. Esophagus divided, corpus clearly defined with distal bulb, posterior portion not distinguished into isthmus and bulb (Fig. 13). Excretory pore posterior to distal bulb of anterior esophagus, small, difficult to see. Nerve ring elongate, cellular in appearance, extends poste-

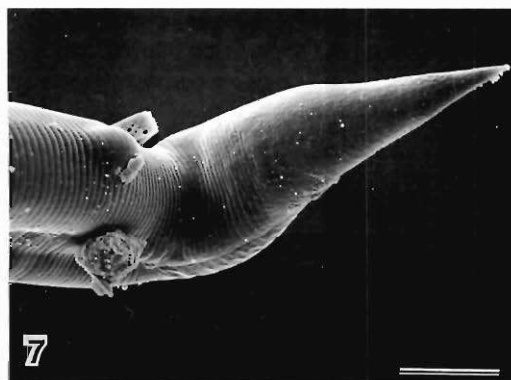
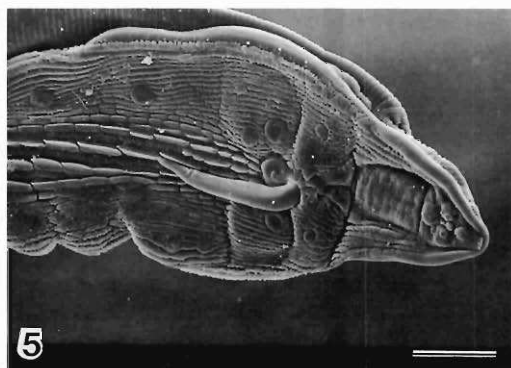
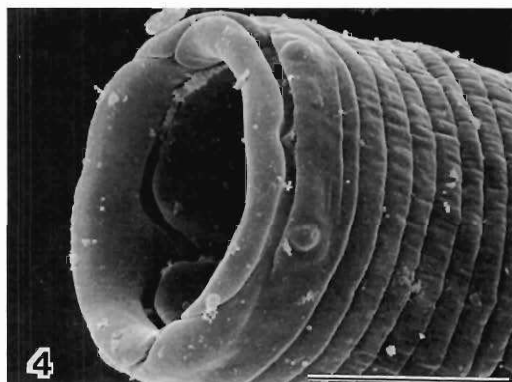
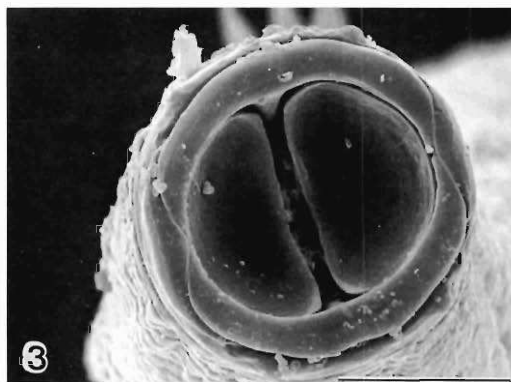
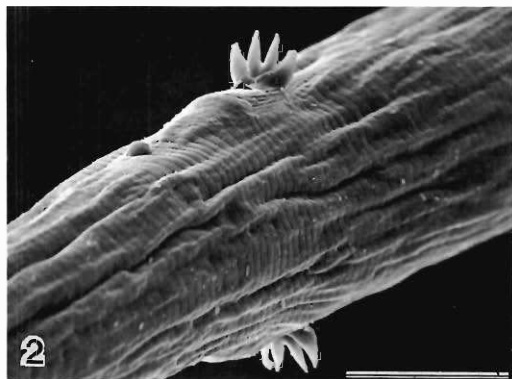
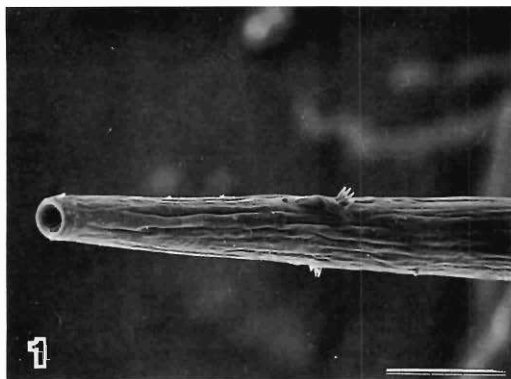
riorly from distal end of corpus of esophagus (Fig. 14).

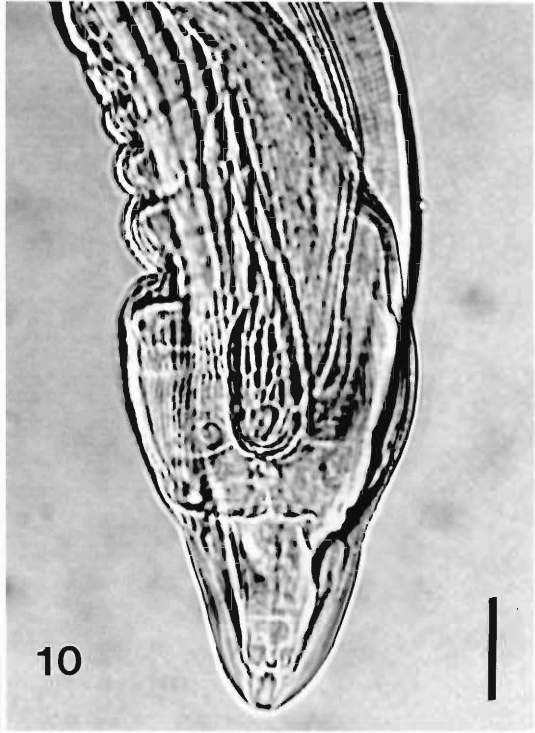
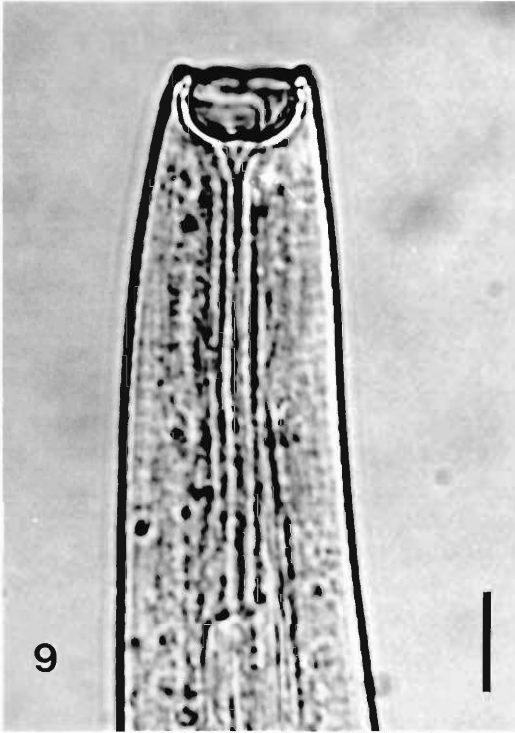
**MALE:** Body 2.2–2.9 long; maximum width 0.08–0.10, 0.040–0.068 wide just anterior to male caudal alae. Head 0.019–0.024 wide. Buccal capsule 0.014–0.020 wide, 0.010–0.012 deep. Esophagus 0.59–0.72 long, corpus 0.12–0.18 long, posterior esophagus 0.37–0.57 long. Cervical papillae, nerve ring, and excretory pore 0.11–0.16, 0.13–0.19, and 0.14–0.17, respectively, from anterior end. Nerve ring 0.03–0.05 long. Right and left spicules 0.09–0.11 and 0.16–0.22 long, respectively (Figs. 5, 6, 10, 17). Right spicule with distal barb (Fig. 18). Gubernaculum absent, dorsal wall of spicular pouch lightly sclerotized. Single sessile papilla just anterior to cloaca. Caudal papillae, 8 pairs (Fig. 16); 5 pairs pedunculate and asymmetrically arranged; third and fourth pair from anterior and open toward ventral median line, first, second and fifth open lateroventrally; 3 pairs sessile near distal tip, median pair separated by cuticular ridge; between median and distal pair of papillae a pair of small pores open which possibly represent the phasmids (Fig. 16). Two small refractive projections form distal margin of ventral cuticular flap on distal tip of tail. Slender caudal alae present. Discontinuous longitudinal cuticular ridges extend on ventral surface from commencement of caudal alae to just anterior to cloaca.

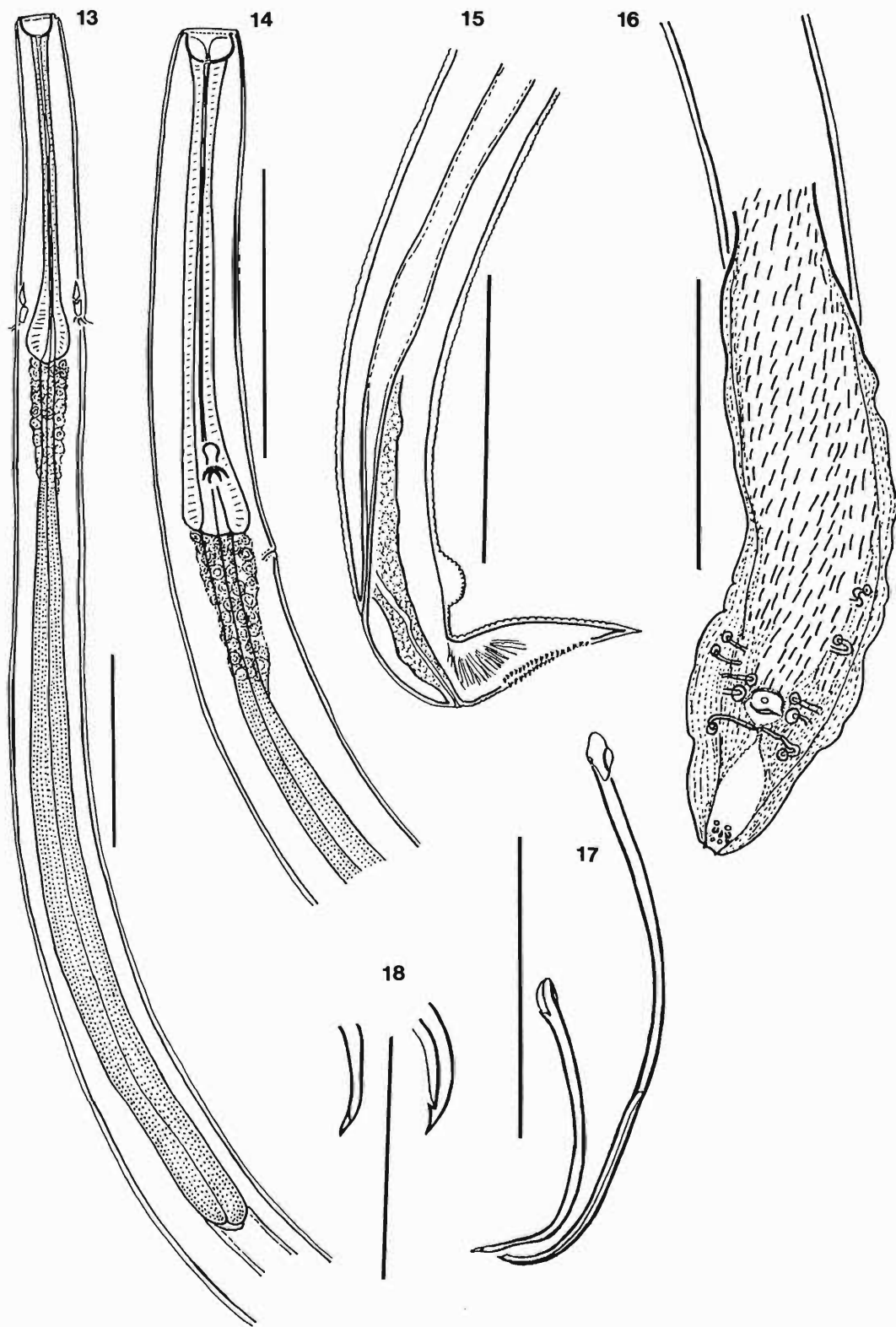
**FEMALE:** Body 2.70–3.24 long, width 0.09–0.12, 0.03–0.04 just anterior to vulva. Head 0.02–0.03 wide. Buccal capsule 0.01–0.02 wide, 0.01–0.14 deep. Esophagus 0.50–0.74 long, corpus 0.014–0.019 long, posterior esophagus 0.40–0.56 long. Cervical papillae, nerve ring, and excretory pore 0.13–0.17, 0.15–0.20, and 0.15–0.18, respectively, from anterior end. Nerve ring 0.04–0.06 long. Monodelphic, ovary 0.19–0.24 from distal end of esophagus. Vulva opens 0.10–0.14 from distal tip of tail and is near anus. Vesicular swelling of cuticle on dorsal surface directly op-

→  
Figures 1–8. Scanning electron micrographs of *Diceronema versterae* gen. n., sp. n. 1. Anterior end of female showing mouth and cervical papillae. Scale bar = 50  $\mu$ m. 2. Cervical papillae of female. Scale bar = 20  $\mu$ m. 3. En face view of female showing dorsal and ventral lips and semilunar plates of the buccal capsule. Scale bar = 10  $\mu$ m. 4. Anterior end of female showing cephalic papillae. Scale bar = 10  $\mu$ m. 5. Tail of male showing papillae, ventral view. Scale bar = 20  $\mu$ m. 6. Recurved tail of male showing postcloacal papillae and caudal alae. Scale bar = 10  $\mu$ m. 7. Tail of female showing vesicular swelling on dorsal surface of cuticle. Scale bar = 20  $\mu$ m. 8. Tail of female showing recurrent line of spines on ventral surface. Scale bar = 20  $\mu$ m.

Figures 9–12. Photomicrographs of *Diceronema versterae* gen. n., sp. n. 9. Anterior end of female showing cup-shaped buccal capsule. Scale bar = 10  $\mu$ m. 10. Posterior of male showing subequal spicules and caudal alae. Scale bar = 10  $\mu$ m. 11. Tail of female with vesicular swelling. Scale bar = 10  $\mu$ m. 12. Uterus with larvae. Scale bar = 10  $\mu$ m.







posite vulva (Figs. 7, 11, 15) 0.01–0.02 wide. Posterior margin of vesicle 0.09–0.10 from distal tip of tail. Viviparous, eggs and larvae present in uterus (Fig. 12). Tail 0.06–0.08 (Figs. 7, 8, 11, 15). Recurrent line of short anteriorly directed spines on ventral surface of tail, occasionally line double (Fig. 8). Pair of ventrolateral sensory organs 0.03–0.04 from distal tip of tail probably represent the phasmids.

**SPECIES:** *Diceronema versterae* sp. n.

**TYPE HOST:** *Diceros bicornis bicornis*.

**SITE:** Stomach.

**TYPE LOCALITY:** Umfolozi Game Reserve, KwaZulu–Natal, South Africa.

**ETYMOLOGY:** This genus is named after the host, *Diceros bicornis bicornis*, and the species is named after the late Professor Anna Verster, a prominent helminthologist.

**TYPE MATERIAL:** USDA National Parasite Collection; Holotype no. USNPC 84838, Paratype no. USNPC 84839. Helminth collection of the International Institute of Parasitology, United Kingdom; Paratype nos. B1059B, S1093B.

### Discussion

Although some of the features of the specimens described herein, particularly the morphology of the male tail, suggest that they should be placed in the order Spirurida, the esophagus is clearly divided into 2 parts, a precloacal sucker is absent on the male tail, the female vulva opens posteriorly, and the females are viviparous, all characters which suggest that they are close to the family Atractidae of the order Ascaridida. Skrjabin et al. (1964) reviewed the family Atractidae and pointed out that at first the genus *Atractis* was associated with the genus *Ascaris* but later was placed with *Oxyuris* in the superfamily Oxyuroidea. Chabaud and Petter (1960) referred the family Atractidae to the superfamily Cosmoceroidea and this classification is now generally accepted. Chabaud (1965) confirmed the inclusion of the Atractidae within the Cosmoceroidea but considered the group to be intermediary between the oxyurids and cosmoceroids. Chabaud (1978) accepted 20 genera in the family

Atractidae. Adamson and Baccam (1988) accepted 14 genera in the family and characterized the Atractidae as having an esophagus distinctly divided at the junction of the corpus and the isthmus. They divided the family into 2 groups, the first didelphic with an esophagus with a long, narrow pharyngeal portion which includes *Fitsimmonsnesia* and *Probstmayria* and the second *Paratractis*, *Cyrtosomum*, *Rondonia*, *Monohysterides*, *Proatractis*, *Cobboldina*, *Orientatractis*, *Labidurus*, *Grassinema*, *Leiperenia*, and *Crossocephalus*. Khalil and Gibbons (1988) and Gibbons et al. (1995) added 2 more genera to the second group, namely, *Buckleyatractis* and *Podocnematractis*, respectively. The specimens described herein show some similarities to the genus *Cobboldina* Leiper, 1911 from the hippopotamus in the shape and structure of the esophagus and the position and formation of the nerve ring. They differ from *Cobboldina* and all the other genera of the Atractidae in the presence of a cup-shaped buccal capsule, the structure of the cervical papillae, the restriction of spines to the ventral surface of the female tail, the presence of caudal alae on the posterior end of the male, the ornamentation on the ventral surface of the posterior end of the male, and the structure and arrangement of the male caudal papillae. For these reasons a new genus *Diceronema*, after the host *Diceros bicornis bicornis*, and a new species, *D. versterae*, after the late Professor Anna Verster, are erected for these specimens.

### Acknowledgments

The authors thank Mr. D. Boshoff and Mr. J. Lourens for technical assistance; Mr. H. Els for scanning electron microscopy; Mr. T. E. Krecek for assistance with drawings; Dr. L. F. Khalil for his helpful discussion on the various features of the specimens described and constructive criticism of the draft manuscript; Mrs. A. Lubbe for assistance with typing of the manuscript; and the Foundation for Research Development and University of Pretoria for financial support. This study forms part of the Wildlife Research Program at the Faculty of Veterinary Science, Uni-

Figures 13–18. Drawing tube illustrations of *Diceronema versterae* gen. n., sp. n. 13. Anterior end of female, dorsal-ventral view. Scale bar = 0.05 mm. 14. Higher magnification of anterior end of female, lateral view. Scale bar = 0.10 mm. 15. Posterior end of female, lateral view. Scale bar = 0.10 mm. 16. Posterior end of male, composite ventral view from light and scanning electron microscopical studies. Scale bar = 0.10 mm. 17. Spicules dissected out of tissues. Scale bar = 0.10 mm. 18. Dorsal tip of right spicule. Scale bar = 0.05 mm.

versity of Pretoria. This is contribution no. J-3065 from the Montana State University Agricultural Experiment Station.

#### Literature Cited

- Adamson, M. L., and D. Baccam.** 1988. Systematic revision of the Atractidae *sensu* Chabaud (1978) (Nematoda: Cosmocercoidea): *Maracaya belemensis* n.sp. and *Aplectana albae* n.sp. from *Amphisbaena alba* in Brazil. Canadian Journal of Zoology 66:1857-1864.
- Chabaud, A. G.** 1965. Ordre des Ascaridida. Pages 732-1497 in P.-P. Grassé ed. Traité de Zoologie. Anatomie Systématique, Biologie. Tome IV. Nématelminthes (Nématodes, Gordiacés) Rotifères, Gastrotriches, Kinorhynques. (Troisième Fascicule) Masson et Cie, Paris, France.
- . 1978. Key to the genera of the superfamilies Cosmocercoidea, Seuratoidea, Heterakoidea and Subuluroidea. In R. C. Anderson, A. G. Chabaud, and S. Willmott eds. CIH keys to the Nematode Parasites of Vertebrates. Farnham Royal: Commonwealth Agricultural Bureaux, No. 6, 71 pp.
- Chabaud, A. G., and A. J. Petter.** 1960. Sur les nématodes Atractidés. Libro Homenaje al Dr. Eduardo Caballero y Caballero, Jubilo 1930-1960. Mexico City, Instituto Politecnico Nacional, pp. 465-470.
- Gibbons, L. M., L. F. Khalil, and C. J. Marinkelle.** 1995. A new nematode genus, *Podocnematractis*, for *Atractis orteppi* Thapar, 1925 (Cosmocercoidea: Atractidae) and the description of another new species, *P. colombianaensis* from turtles *Podocnemis* spp. in Colombia. Systematic Parasitology 30:47-56.
- Khalil, L. F., and L. M. Gibbons.** 1988. Two nematodes, *Paratractis hystrix* (Diesing, 1851) and *Buckleyatractis marinkelli* n.g., n.sp. (Atractidae: Cosmocercoidea) from *Podocnemis* spp. in Colombia. Systematic Parasitology 12:187-198.
- Skrjabin, K. I., N. P. Shikhobalova, and E. A. Lagodovskaya.** 1964. [Oxyurata of animals and man.] Osnovy Nematologii, 13. Moscow: Izdatel'stvo Akademii Nauk SSSR. 468 pp. (In Russian. English translation by the Israel Program for Scientific Translations, Jerusalem, 1976.)